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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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[x] *Additional inventors are being named on the* one *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

Radial Flow Filter Apparatus and Systems

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ENCLOSED APPLICATION PARTS ***(check all that apply)***

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Respectfully submitted,

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Date 4/16/2004

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Additional Page

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Number 2 of 2

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RADIAL FLOW FILTER APPARATUS AND SYSTEMS

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Technical Field Of The Invention

The present invention relates in general to filters and associated filter systems, and more particularly to radial flow filters of the type that allow the media to be fluidized external thereto.

Detailed Description

Fig. 1 illustrates a device 10, although in practice it may be much longer in length, up to six foot or more, depending on the surface area of filter media desired. The device 10 includes a top end cap12 and a bottom end cap 14. Both top and bottom end caps 12 and 14 may be constructed in an identical manner, using the same mold. The end caps can be constructed of plastic, metal or other suitable material.

Supported between the end caps 12 and 14 is an outer cylindrical case 16 that is supported between respective annular recesses in the top and bottom end caps 12 and 14. The case 16 can be welded or threaded to the top and bottom end caps 12 and 14 to constrain the perforated cylinders 22 and 32 between the end caps 12 and 14. O-rings 18 and 20 provide a fluid seal between the case 16 and the top and bottom end caps 12 and 14.

The top and bottom end caps 12 and 14 further include other respective annular recesses for supporting therebetween an outer perforated cylinder 22. The outer perforated cylinder 22 may be plastic or metal with large openings 24 formed therein. The openings 24 are formed generally throughout the entire length of the outer perforated cylinder 22. (However, the perforations can be formed along any desired portion thereof). This allows the entire surface area of the outer perforated cylinder 22 to receive a radial flow of influent. A screen 26 is attached to the inside surface of the outer perforated cylinder 22. O-rings 28 and 30 provide a fluid seal between the outer perforated cylinder 22 and the respective top and bottom end caps 12 and 14.

An inner perforated cylinder 32 is supported within respective bores (not shown) formed centrally in the top and bottom end caps 12 and 14. O-rings (not shown) provide a fluid seal between the ends of the top and bottom ends of the inner perforated cylinder 32 and the respective bores of the top and bottom end caps 12 and 14. Large perforations 34 are formed in the inner perforated cylinder 32 from the top to the bottom thereof. A screen 36 is attached to the outer surface of the inner perforated cylinder 32. The screen 26 held against the inside surface of the outer perforated cylinder 22, and the screen 36 held against the outer surface of the inner perforated cylinder 32, are of a mesh or porosity for containing the media 40 placed in the annular chamber 38 between such screens 26 and 36.

A media, such as beads, activated carbon, particulate zirconium or any other filter material 40 is carried to the device 10 to fill the annular chamber 38. The media material 40 can also be of any other material that coacts with the influent, rather than filters the influent. The annular chamber is called the media chamber 38. The particles of the media 40 are preferably larger in diameter than the screens 26 and 32, although they may be smaller when desired. The media 40 can be injected into the media chamber 38 either by way of a channel 44 located in the top end cap 12, or the bottom channel 42 located in the bottom end cap 14. In the preferred embodiment, the media 40 fills the media chamber 38. During regeneration of the media 40, the media 40 is removed from the device 10 through a channel 42 located in the bottom end cap 14.

While the top end cap 12 and the bottom end cap 14 are shown with a single media inlet channel 44 and outlet channel 42, such end caps can be constructed with multiple channels to facilitate the inlet and outlet of the media 40 with respect to the device 10. In order to allow uniform distribution of the media around the media chamber 38, two inlet channels 44 can be formed oppositely in the top end cap 12. Similarly, for complete removal of the media 40 from the

media chamber 38 during regeneration thereof, two outlet channels can be oppositely located in the bottom end cap 14. As yet another alternative to the end cap design, the top end cap can be constructed with one or more inlet channels (not shown) opening to an annular groove which will function to uniformly distribute the media 40 around the annular-shaped media chamber 38. The bottom end cap 14 can be formed with a similar structure to assure that the media 40 can be completely removed from the media chamber 38 during the regeneration cycle. As will be described more fully below, the media 40 is removed from the device 10 by a fluidization process, and coupled to a regeneration container for either removing the filtered particulate matter from the filter media, or for regenerating the media chemically or otherwise to reconstitute it to its pristine state.

The inner perforated cylinder 32 has a plate 50 located centrally therein and near the top to prevent fluid flow from the top central port 52 directly to the central core of the inner perforated cylinder 32. The plate 50 is equipped with a ball and seat valve. The ball is captured by a screen cage fastened to the upper surface of the seat plate 50. The cage prevents the ball from being carried away with the liquid.

The upper end of the inner perforated cylinder 32 opens into a top central port 52 formed within the top end cap 12. In like manner, the bottom end of the inner perforated cylinder 32 opens into a bottom central port 54 formed in the bottom end cap 14.

Formed in the top and bottom end caps 12 and 14 are respective annulus ports 56 and 58. The top annulus port 56 opens into an annular channel 60 formed in the top end cap 12. Similarly, the bottom annulus port 58 opens into an annular channel 62 formed in the bottom end cap 14. The annular channels 60 and 62 are in fluid communication with an annular chamber 64 located between the outer surface of the outer perforated cylinder 22 and the inside surface of the case 16.

In operation of the device 10, the desired media 40 is coupled to the media inlet channel 44 via external piping and valve arrangement. The media outlet channel is valved to a closed position. The media 40 is preferably coupled to the device in a liquified form so that it fills the media chamber 38, preferably above the plate 50. If the media 40 does not fill the media chamber 38 above the plate 50, then the influent could be short circuited from the top annulus port 56 directly to the central core of the inner perforated cylinder 32, without being filtered. Once the media chamber 38 is filled with the media 40, the inlet channel 44 and the outlet channel 42 are valved to a closed condition.

Alternatively, this could be done manually or with the assistance of a mechanical device to deliver the media through the top or bottom end cap channels in either the LIQUIFIED or DRY state. This could even be carried out with air, which would have the added advantage that no additional weight would be added to the filter during shipment or drying time, if so desired

after a liquid fill.

During an optional intermediate cycle, called a purge cycle, the media 40 is packed or otherwise caused to settle in the media chamber 38. During this cycle, a liquid is input into the central inlet port 52, and the bottom annulus port 58 is briefly opened to relieve the internal pressure of the device 10. This action allows the liquid to force the media 40 downwardly in the media chamber 38 into a concentrated or packed condition. If needed, additional media 40 can be input into the media chamber 38 as a result of the purge cycle.

During a filter or coacting stage, the undesired matter is removed from the influent. The influent is coupled via external piping and valve arrangement to the top annulus port 56 and or the bottom annulus port 58. The influent is thus coupled to the annular chamber 64 that encircles the entire length of the outer perforated cylinder 22. The influent is forced in a radial direction through the media 40 located in the media chamber 38. chamber 38. The influent that passes through the media particles is effectively filtered or coacted. The filtered influent passes radially through the media 40 and through the openings in the inner perforated cylinder 34 and downwardly in the core of the inner perforated cylinder 34 to the central outlet port 54. From the central outlet port 54, the filtered liquid, i.e., effluent, is carried externally from the system to other equipment for further processing, or to terminal equipment.

The filter process continues until the media has accumulated particulate matter to the extent that the pressure in forcing the influent into the device 10 increases above a predefined threshold. When the device is used for coacting the influent with the media, the coacting cycle continues until there is an indication that the media is no longer effective in removing the desired substance from the influent. In this event, a regeneration procedure or cycle can be instituted.

A system incorporating the device 10 is illustrated in Fig. 2. The regeneration stage is shown. The system includes a valve 72 controlling the outlet channel 42 of the device 10, and a pump (not shown) suited for pumping a liquid into the top central port 52 of the device 10. A container 78 is illustrated of the type adapted for removing particulate matter from the media 40, or regenerating the media 40 to reconstitute it to its pristine condition. The external valving arrangement is switched so that a liquid enters the device 10 via the top central port 52. The liquid is forced into the central core of the inner perforated cylinder 32. The ball in plate 50 forced closed in its seat by the pressure of the liquid. The liquid is thus forced to flow through the openings 34 in the top portion of inner perforated cylinder 32, and into the top of the column of media 40. This applies a downward force on the column of media 40. At the same time, the liquid is forced radially outwardly at the top of the media chamber 38 and into the annular chamber 64, to the bottom thereof. The liquid in the annular chamber 64 reenters the media chamber 38 at the bottom thereof and tends to liquify the media and flush it down the outlet channel 42, through the open valve 72 and to the container 78. Once the media 40 begins to fluidize and be carried out the outlet channel 42, there is an avalanche effect that results in the

quick and efficient removal of the media 40 from the device 10.

Alternatively, no top ball in plate 50 need be used and the media itself at the bottom would provide the resistance in like manner to the flow in the outside annular to prevent fluid from short circuiting and therefore force the fluid along with the media on out the bottom 42.

The media is regenerated by conventional means in the container 78 or other regeneration system. In the event the media 40 are beads, the container can be equipped with equipment so that a liquid is forced into the bottom of the container with sufficient velocity so that the axial drag forces overcome the buoyant weight of the media beads, whereupon fluidization occurs and the particulate matter is separated from the media and carried out of the top of the container 78. For other types of media chemicals, heat and other materials can be used to regenerate the media 40. This is particularly advantageous where additional lifting forces are required to fluidize the media where heavy, large, angular, etc., media is being used. The container 78 provides total axial flow (which would not be possible in a radial flow filter where perforations are employed), thereby maximizing the drag forces and therefore the lifting capacity on the media in the axial direction.

In accordance to an important feature of the invention, much less liquid is required during the regeneration cycle, as compared to prior art systems. In other applications, the container 78 may be physically located below the device 10, in which event the media 40 can be allowed to be fluidized by the action of gravity, and be carried to the container where it is regenerated.

Fig. 3 illustrates the system in the state in which the media is resupplied to the device 10. After the media 40 has been regenerated in the container 78, it is pumped by a pump 80 in a slurry through the open valve 82 to the inlet channel 44 of the device 10. The slurry of media 40 is carried into the media chamber 38 and fills it from bottom to the top thereof. The outlet channel 42 of the device can be vented to relieve internal pressure during the refilling cycle and expedite filling of the media chamber 38 with the regenerated media 40.

In other systems, one or more containers 78 can be utilized for regenerating the media 40. One container 78 can be employed to regenerate the media 40 and hold the regenerated media 40 until needed. While the device is operating to filter or coact an influent, the media chamber 38 is filled with the media 40. When it is time to regenerate the media, the media 40 can be carried from the device 10 to the second container where it is regenerated. During regeneration of the media 40 in the second container 78b, the regenerated media 40 held in the first container 78a can be pumped into the media chamber of the device 10 an it can be placed into operation during the regeneration of the spent media in the second container 78b.

This same process can be carried out with a number of devices 10a, 10b....10n as shown in Fig. 4. Here, a single container 78 can be employed to sequentially regenerate the media 40

from plural devices. In addition, plural containers can also be used to regenerate the media in a system of plural devices.

The foregoing system is well adapted for use with media that is difficult to fluidize within the device itself, as described in U.S. Pat. No. 6,322,704 by Martin. Such systems may include a device 10 using a zirconium powder as a media to filter arsenic form water. The zirconium media can be regenerated chemically in the container 78, the regeneration system or in the filter itself.

From the foregoing, the various advantages of the invention are set forth below.

No backwash chamber needed, although could still be included where applicable.

No orifices needed for fluidization although could still be included where applicable, such as where periodic backwashing of the media is desirable.

One check valve approximately 4 - 5 inches down from the top of the inside cylinder to prevent channeling of the fluid at the top during the filter cycle, if so desired or where needed.

Mechanism of fluidization out the bottom - Media itself replaces the resistances in both the outside annular and the inside cylinder to produce the axial forces required to discharge the media out of the filter, along with gravity working with the fluidization process instead of against it as in the case where the media is fluidized to the top and therefore have to overcome gravity in the process..

Media may be completely removed to an external vessel separate from the filter.

End Caps contain media access thru ports, channels, grooves or other means so media can be discharged from the filter.

After media is discharged thru the bottom it may be followed by a filter or spray cycle to remove any of the media that may still be left up in the filter, especially any media that may be next to the inside of the outside filter screen.

Fluidization out the bottom provides a superior job of removing any media next to the inside of the outside filter screen compared to normal fluidization into a top backwash chamber.

The very real possibility exists that an otter solid shell that forms the annular space between the outside perforated filter chamber and the inside of such outside shell may not even be necessary which would allow for multiple element cases and other means of piping

arrangement.

Filters may be placed vertically or horizontally and recharged in place or removed and regenerated either vertically or horizontally or even inverted.

A quick connect on the end cap could replace the port or channel and allow for quick media change out.

The regeneration stage can take place in the filter itself with or without a backwash chamber.

Holes along both the inner perforated cylinder and the outside perforated cylinder can be along the entire lengths of both cylinders, or only some portion thereof.

Lastly, there may be times when the regeneration process described in Fig. 2 can be done in the device 10 itself.

In accordance with another feature of the invention, the inner perforated cylinder 32 can be constructed in a segmented manner, such as shown in Fig. 5. In a preferred embodiment, the inner perforated cylinder 32 is constructed of a synthetic moldable material, such as plastic. Moreover, the inner perforated cylinder 32 is fabricated with a number of similarly-made segments, one shown enlarged as reference numeral 86. Each segment 86 is fixed together in an end-to-end manner to form the column and thus the inner perforated cylinder 32. This overcomes the problem in producing long-length items by plastic molding processes. Because draft angles are required in molding items, long items are difficult to make by conventional molding processes without compromising the percent open area in the molded part.

Each segment 86 is preferably molded from any type of moldable material. Each segment 86 includes a tubular sidewall 88 with a top plate 90 and an open bottom 92. The top plate 90 is recessed somewhat from the annular edge of the segment, includes one or more orifices 94 to facilitate fluidization of the media in the device, such as described in detail in the Martin patent 6,322,704. The segment 86 can be molded with a line of weakness 98 so that the top plate 90 can be removed in the event that the orifices are not needed, such as the embodiment of the device 10 described above in connection with Fig. 1. The top plate 90 can be drilled with a large hole in the event that no orifices are needed. The top plate 90 can be unmodified to provide a plug in the cylinder. Alternatively, the segment can be molded without any end plates. The orifices 94 can be drilled into the top plate 90 with different sizes and different patterns in the various segments 86.

Formed in the sidewall 88 of the segment 86 are perforations 96 formed during the molding process.. Alternatively, the perforations 96 can be formed during the molding process

as "knock-out" structures which can be removed during the assembly of the column of segments 86 to form the inner perforated cylinder 32. If it is desired to form an aperture in the sidewall 88, then the particular knock-out can be punched through the sidewall 88, thereby forming the aperture.

The segments 86 can be molded in various diameters, and with desired axial lengths. For example, a segment adapted for use in making an inner perforated cylinder 32 can be two inches in diameter and three inches long. Thus, in order to fabricate an inner perforated cylindrical 32 of an overall length of five feet, twenty three-inch long segments 86 would be employed.

The segments 86 can be fixed together to form a column by bonding the annular edges of the segments 86 together. The bonding agent can be an adhesive, a chemical weld, a thermal weld or any other means suited for fixing plastic elements together. In the preferred form, the segments 86 are spin welded together. According to this technique, the segments 86 to be fixed together are rotated in opposite directions at a high speed. The segments 86 are then brought together at the annular edges, whereupon the contact therebetween causes heat to be generated. The heat melts the plastic material so that it flows together and forms a unitary and strong unit. Additional segments 86 are added to the partially formed column to build an inner perforated cylinder 32, such as shown in Fig. 1. This provides an economical and efficient method of forming the inner perforated cylinders, and allows for various model lengths in sizes by varying the number of parts assembled. The outer perforated cylinder 22 can be fabricated in the same manner.

Fig. 6 illustrates a filter or coaction system where filters similar to that shown in Fig. 1 are employed in a large container 100. The devices 102, of which there may be many in the container 100 are like that of Fig. 1, but without the outer case 16. Rather, the influent entering the container 100 through the inlet 104 is carried directly to the outside surface of the outer perforated cylinder 22. The influent is filtered by being carried radially through the media 40, and the filtered fluid exits the individual devices 102 via the respective bottom central ports 54. The bottom central ports 54 of each of the devices 102 are plumbed together into a common outlet 106. With this arrangement, only a single large container is employed, rather than a case on each of the individual devices 102. The piping for the other ports of the devices 102 is not shown in Fig. 6, but would be apparent to those skilled in the art in view of the foregoing description. In this case fluidization, if needed, would be out the bottom with the accompanying fill cycle either back through the bottom or in through the top.

Fig. 7 illustrates another embodiment of a device 110 for use in filtering or coacting an influent with a media. The device 110 is similar to that shown in Fig. 1, but includes a spray liner 112. The spray liner 112 is situated between the case 16 and the outer perforated cylinder 22. The spray liner 112 includes a small hole or jet located therein in a position aligned with the perforations of the outer perforated cylinder 22. In the example, the spray liner 112 includes a

small hole 114 or jet radially aligned with the perforation 24 of the outer perforated cylinder 22. The top and bottom end caps 12 and 14 are constructed to hold the spray liner 112 and the case 16 in the position shown. The bottom end cap 14 includes a port 116 connected to a source of air pressure. The air port 116 could also be formed in the top end cap 12, or both the top and bottom end caps 12 and 14.

In operation of the device 110, once it is determined that the outside surface of the filter media is being clogged with particulate matter, especially in the media area exposed by the perforations 24 in the outer perforated cylinder 22, the particulate matter can be removed by use of the spray liner 112. The device 110 is temporarily taken off line and all valves to the device 110 are closed. The device 110 is then pressurized via the air port 116 to a desired pressure. The valve to the bottom annulus port 58 is abruptly opened. The valve to the top annulus port 56 can also be opened. In any event, the pressure within the device 110 is relieved, which causes the pressurized air to jet liquid through the small holes 114 in the spray liner 112 and be directed to the respective perforations 24 in the outer perforated cylinder 22. The jets of pressurized liquid cause the particulate matter clogging the media to be dislodged and carried to the bottom of the device 110. The dislodged particulate matter can be carried out of the device 110 and disposed of appropriately. The velocity of the pressurized air in combination with the mass of the liquid provide an excellent mechanism for dislodging the caked particulate matter from the media.

The advantage of the use of the spray liner 112 is that the time between backwashing can be substantially lengthened, by a factor of 4 or 5. For example, when it determined that the media is being clogged with particulate matter, the use of the air jets can be used once an hour, rather than backwashing, and then the device 110 can be backwashed at five-hour intervals. An additional advantage is that very little, if any, water is needed during the spray cleaning cycle. Another avantage is the total life of the filter may be greatly prolonged because progressive fouling of the outside screen will be avoided or greatly slowed down. Those skilled in the art may find that jets of both air and a liquid can be used, or a gas other than atmospheric air.

The device 10 of Fig. 1 can also function as a cross flow device. In a cross flow device, not all of the influent passes through the media. Rather, some of the more particle-laden influent bypasses the media and is carried to a clarifier or other settling vessel. The device 10 is situated in a system in which the influent is input into the annulus input 56 and is carried into the annular volume 64. Part of the less particle-laden influent is carried radially through the media 40, while the heavier and larger particles are carried downwardly and swept out of the lower annulus port 58 to be carried to a clarifier or feed water. It is believed that the velocity vectors characteristic of the influent are not sufficiently strong in the radial direction (with respect to the larger particles), and thus such particles bypass the filter media. With this operation of the device 10, the media does not become prematurely clogged with the larger particles. The device 10 otherwise functions in the manner described above.

In addition to the foregoing, the spray liner 112 of the device of Fig. 7 can be employed in the cross flow device in order to facilitate axial flow of the large particles, and deter such particles from being carried in a radial direction through the holes 114 of the spray liner 112 and to the media. In this case, the influent would be input in to the annular area between the case 16 and the spray liner 112 through modified end caps. The spray liner 112 in this embodiment functions to prefilter the influent and deter the larger particles from flowing radially to the media.

Filter and coacting devices are incorporated into systems comprised of other equipment. The devices are controlled by a number of solenoid-operated valves by a process controller. The solenoid valves are expensive, and thus a reduction of the number of valves represents a reduction in costs. Fig. 8 illustrates demonstration system including a filter 120, a backwash chamber 122 and a multiport valve controlled by a solenoid. The control of the multiport valve 124 is by a system controller 125 to rotate the valve 124 and allow the interconnection and open/closed condition of the various ports. This valving arrangement thus simplifies the system connections to the filter 120, at a reduced expense.

The filter unit 120 is of the radial flow design with a central inlet port 126 coupled to the inner perforated cylinder. A top outside annular port 128 is coupled to the annular area between the case and the outer perforated cylinder. At the bottom of the filter unit 120, there is a central outlet port 130 and a bottom outside annular port 132. The various connections between the filter 120 and the multiport valve 124 are shown in Fig. 8. The backwash tank 122 is connected to a pump 134 to the central port 5 of the multiport valve 124. The inlet of the backwash tank 122 is connected to port 6 of the multiport valve 124.

The multiport valve 124 is configured so that ports 5 and 6 are always open. The state of the other ports of the multiport valve 124 is as shown in Fig. 8. In addition, the state of the ports are shown for the various filter cycles, namely, the filter cycle, the backwash cycle and the backpack or purge cycle. The system controller controls the rotation of the multiport valve to positions to achieve the various cycles.

According to another embodiment of the invention, there is shown in Figs. 9a-9d a six-position multiport valve for use with systems employing multiple cycles. Fig. 9a illustrates the physical nature of the multiport valve 140, with a fluid inlet port 2 in the top of the valve, which feeds the fluid to the other ports as a function of the rotary position of the control shaft 142. The control shaft 142 is rotated by an electrical mechanism (not shown) which, in turn is controlled by the system controller. The shaft 142 can be rotated to six different positions, corresponding to different cycles of the system. In a system employing a filter device, the cycles may include a filter cycle, pressure-up cycle (air), an annular purge cycle (air and water), a backwash cycle, a blow down or backpack cycle and a rinse cycle.

Fig 9b illustrates the top plate 144 of the multiport valve 140, and Fig. 9b illustrates the bottom plate of the valve 140. The top plate 144 moves with the control shaft 142, whereas the bottom plate 146 remains stationary. The cross-hatched areas of the top plate are concaved upwardly, as shown in Fig. 9d as to numeral 148, to allow communication between two fluid channels of the bottom plate 146. The concave areas 148 function as an open valve between the two fluid channels of the bottom plate 146. The flat areas, such as 150, of the top plate 144 are effective to close off two adjacent channels of the bottom plate 146 and effective function as a closed valve therebetween.

The top plate 144 is made rotatable over the bottom plate 146 top six index positions. The top plate 144 can be rotated so that the index mark 152 aligns with one of the six index marks of the bottom plate146, shown as heavy lines. If the top plate 144 is superimposed over the bottom plate 146 so that the top index mark 152 is aligned with the various index marks of the bottom plate 146, then it can be seen how the various channels are either coupled to adjacent channels, or blocked.

Fluid input to the top port 2 is carried to all upper areas of the top plate 144, and thus is coupled to open channel 2. Depending on the indexing of the top plate 144, the fluid is coupled from top channel 2 to other open channels of the bottom plate 146. The inlet fluid carried by channel 2 of the top plate is used in the filter cycle, the backwash cycle, the blow down (backpack) cycle and the rinse cycle. The rinse cycle is utilized to clean the filter with fresh water subsequent to a backwash cycle and prior to the filter cycle to cleanse the filter of any backwash residue. The various channels of the bottom plate 146 include the top annular of the filter device, the top inner perforated cylinder (I/S), the effluent, blow down (backpack) and waste.

The six-position multiport valve 140 has four positions for liquids, and two positions for a gas. Importantly, there is provided near the center of the top plate 144 and the bottom plate 146 ports or channels for carrying a fluid, which may be air, gas or a liquid. The cross hatched portion of the bottom plate 146 shown in Fig. 9c represents planar plate portions thereof. Index positions 2 and 3 corresponds to cycles where pressurized air is injected into the filter system. Importantly, the multiport valve 140 is constructed so that the liquid portions and the air portions are maintained separate. This is advantageous when the system is used to filter drinking water. This keeps the filter cycle valves completely separated from the backwash cycle valves and prevents contamination.

The foregoing multiport valve can be configured to carry out many other types of cycles, different from that described above. For example, when it is desired to carry out a media exchange cycle and no spray liner is used, the pressure up cycle and the annular purge cycle can be replaced with a media discharge cycle and a media fill cycle. The cycles can be changes and substituted for other cycles by changing the plumbing external to the multiport valve 140.

Fig. 11 illustrates a standard radial flow filter 160 incorporating many fo the features of the invention. In this filter, the inner perforated cylinder has a media filling only the bottom half of the media chamber. A plug separates the top of the inner perforated cylinder from a top portion thereof. Feed water is input into the top center port during filtering, and backwash liquid is extracted from such port during the backwash cycle in which the media is fluidized to the upper part of the media chamber.

Fig. 12 illustrates a submerged type of filter 170 employed in a clarifier The filter 170 does not include an outer case, but rather the outer perforated cylinder 172 is exposed to the influent in the clairfier. The inner perforated cylinder has a bottom connected to flexible piping for carrying backwash liquid in one direction, or filtered liquid in the other direction. The clarifier includes in a standard manner a number of settling plates 174 at the bottom thereof. The submerged filter includes an enclosure 176 fixed to the clarifier. The filter 170 is adapted for moving telescopically within the enclosure 176. The filter 170 can be moved upwardly, as shown, by a hoist mechanism, hydraulic system or other suitable means.

In operation of the system of Fig. 12, the filter column 172 is placed in it lower position, as shown, whereupon the influent in the clarifier moves radially through the media column 172, down the inner perforated cylinder, and exits out of the clarifier. When it is desired to backwash the filter 170 to remove the particulate matter from the media column 1172, the filter 172 is raised up in the enclosure 176 until the bottom plate 178 abuts against the bottom edge 180 of the enclosure 176. In this position, the filter 170 can undergo a backwash cycle to regenerate the media, without being removed from the clarifier.

The submerged filtration technique can also be carried out in alternative ways. For example, a clarifier may or may not be used. The filter unit can be equipped with a case 16, such as shown in Fig. 1. The lifting mechanism for the filter may not be necessary during the fluidizing and regeneration cycle. Instead, the fluidizing of the filter may be carried out of the bottom of the filter through a port and carried external to the clarifier. In the event that the lifting mechanism is employed, it can be a cable and winch, or hydraulic, in which event the hydraulic fluid it introduced into a bottom plate section and forced to the filter to displace it into the outer casing located either above or below the filter to fluidize the media.

In addition to the foregoing features of the invention, other features are available. An air backwash cycle can be employed where air may be injected into the inside perforated cylinder at frequent intervals to prolong the filter cycle. The air injected into the inner perforated cylinder for a central filter port, tends to release the particulate matter from the media and temporarily regenerate the media without a backwash cycle. This is not the same as the air injected in the outside liner. An air backwash cycle can be initiated where air is introduced every 10 seconds

for 2 seconds into the inner perforated cylinder. It has had the effect of allowing the filter to run for hours vs. minutes between backwash cycles and no liquid is used whatsoever in the process which is a very important issue as well. First the effluent valve is shut off, then the air is piped into the inside perforated cylinder and then allowed to exit the outside annular thru either the bottom or top cap. The pulsed air dislodges the particulate matter from the outer surface of the media and carries the dislodged matter out of the filter.

Other features:

Parallel and sequential valving.

Slurry and the advantages of the Fill Cycle where the outside perforated holes in particular run substantially the entire length of the filter.

Self enclosed case.

Annular runs the entire length of the filter.

Manual disassembly of the filter for either changing out the media by removing either of the two end caps or a complete restoration of the filter including replacing the screens and media.

Top inside perforated cylinder bladder -This involves placing a membrane or bladder in the top backwash chamber portion of the filter, inside the inner perforated cylinder and then forcing it to expand out and press against the inside surface of the inner perforated cylinder perforations at the top by introducing either air or water into the membrane or bladder to inflate it. This effectively makes the top backwash inside cylinder as if it had no perforations during the fluidization cycle. This increases the axial forces lifting the media in the top backwash chamber.

Fluidization pulsing- this is where the fluidizing fluid is pulsed by quickly turning the valve open and closed repeatedly. This increase the velocity in the axial direction of the filter, thereby further increasing the lifting capacity of the filter.

Pressure tank with bladder therein to replace air compressor for air injection during the spray liner cycle. This provides the source of pressurized fluid for the spray liner function.

Funnel structure in the molded end caps to help lift the dead zone or area of no flow at the bottom of the cap during the fluidization cycle. The funnel structures facilitate complete fluidization of the media from the bottom of the media chamber. Sometimes without the funnel structures, there is left in the bottom of the media chamber 2-4 inches of media during fluidization.

Backwashable Screen – Due to the unique combination of screen and media interface, especially in regards to the outside perforated cylinder, a virtual invisible screen exists. When particles

contact this barrier they are prevented from moving thru if they are larger than the media or the screen. One of two things can happen, either they will stop on the outside of the screen or pass on into the media and be stopped. If they pass on into the media then they are removed during the fluidization or backwash cycle. If they stay on the outside of the screen they will be removed either during the blowdown cycle or the spray liner cycle and removed in both cases out the annular port either at the top or bottom of the cap.

It should be noted by controlling the size of the particles in the upstream influent (e.g. thru sequential filtration or proper sizing of the filter media and screen) the location of the solids can be controlled.

The media screen relationship is such that for round spherical media the interstitial spacing in the media is approximately 1/7 of the outside diameter of the media itself allowing for a screen sizing of approximately 15 times larger than the media itself. This is can be further increased where angular media is utilized in place of the round spheres. There may also be used media actually smaller than the screen and packed to allow for bridging across the screen holes by multiple media.

What Is Claimed Is:

1. A method of coacting an influent with a media, and for regenerating the media, comprising the steps of:

coacting the influent with the media by passing the influent radially through an annular column of the media contained in an annular-shaped media chamber;

removing the media out of the media chamber by fluidizing the media and carrying the media to a regeneration container;

regenerating the media in the regeneration container;

carrying the media from the regeneration container to the to the media chamber; and

periodically jetting a fluid against at least a surface portion of the media to clean the surface thereof of residue.

2. The method of claim 1, further including using a spray liner with holes therein for producing jets of spray.

3. The method of claim 1, further including recirculating a portion of the influent without coacting of the same.

4. A submerged filter for use with a clarifier, comprising:

an enclosure fixed to the clarifier;

a filter telescopically moved in said enclosure so that when telescoped out of the enclosure, the filter functions in a filter cycle, and when moved within the enclosure, the filter functions in a backwash cycle.

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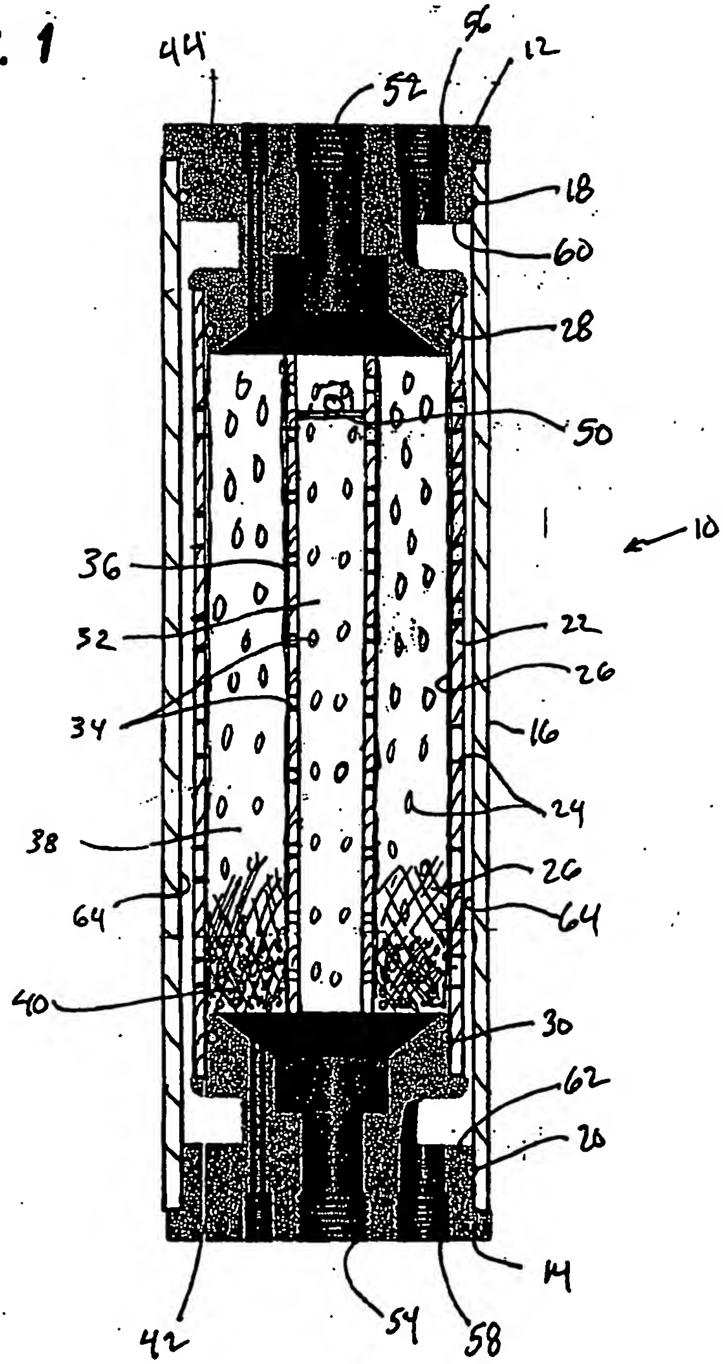
FIG. 1



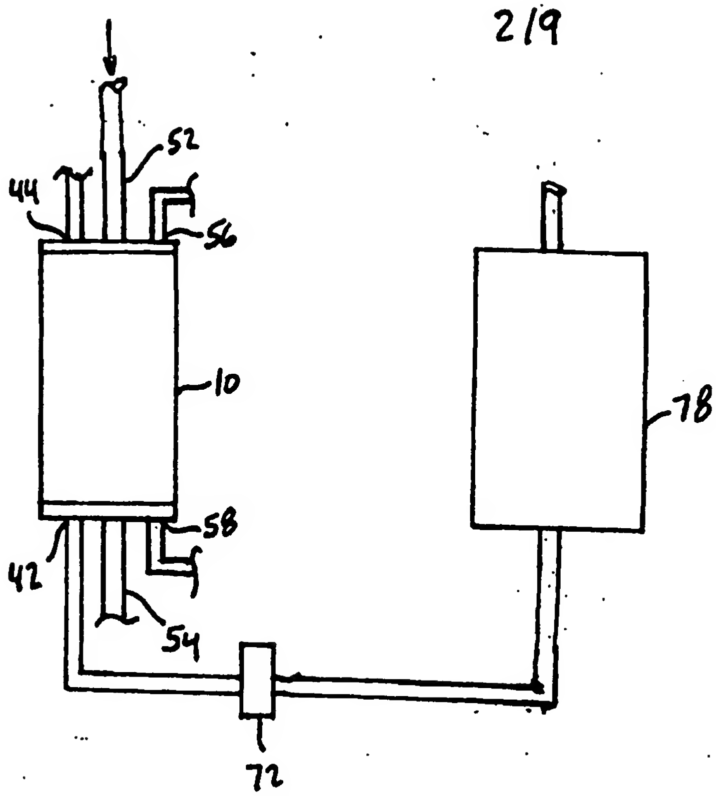


FIG. 2

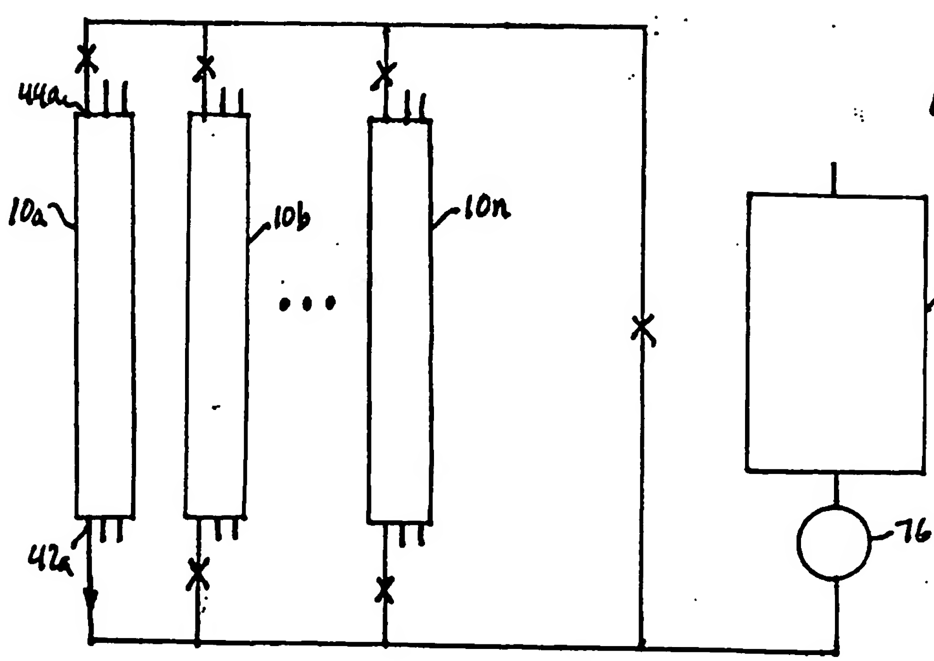


FIG. 4

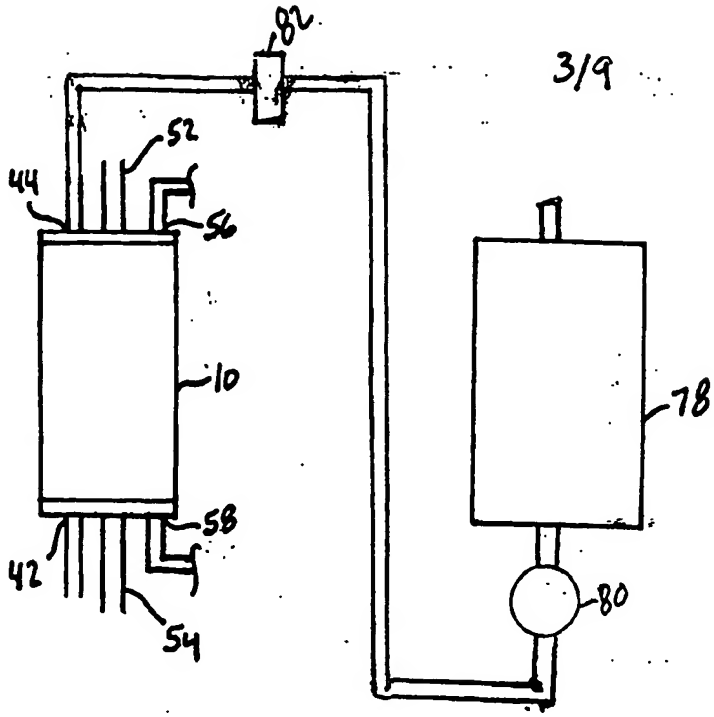
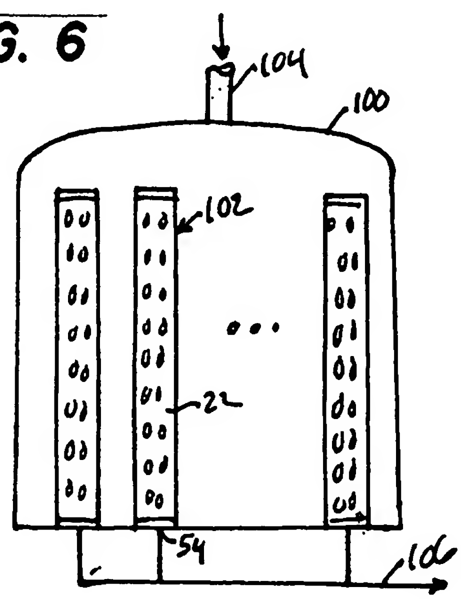
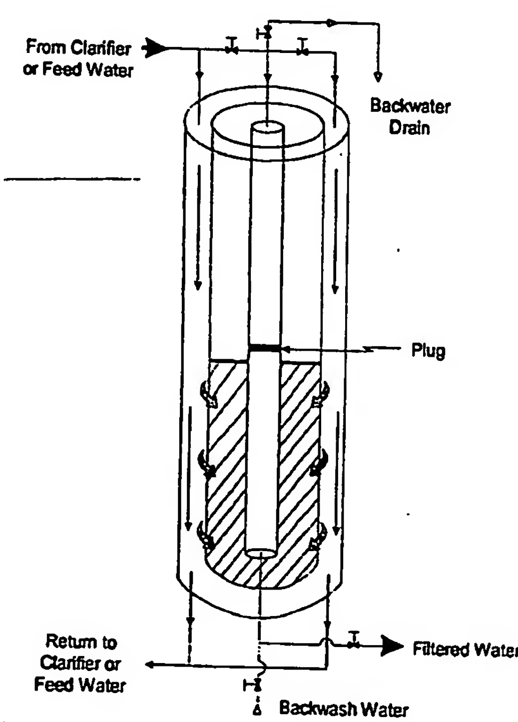


FIG. 3

FIG. 10

FIG. 6





Cross Flow Filtration

FIG. 5

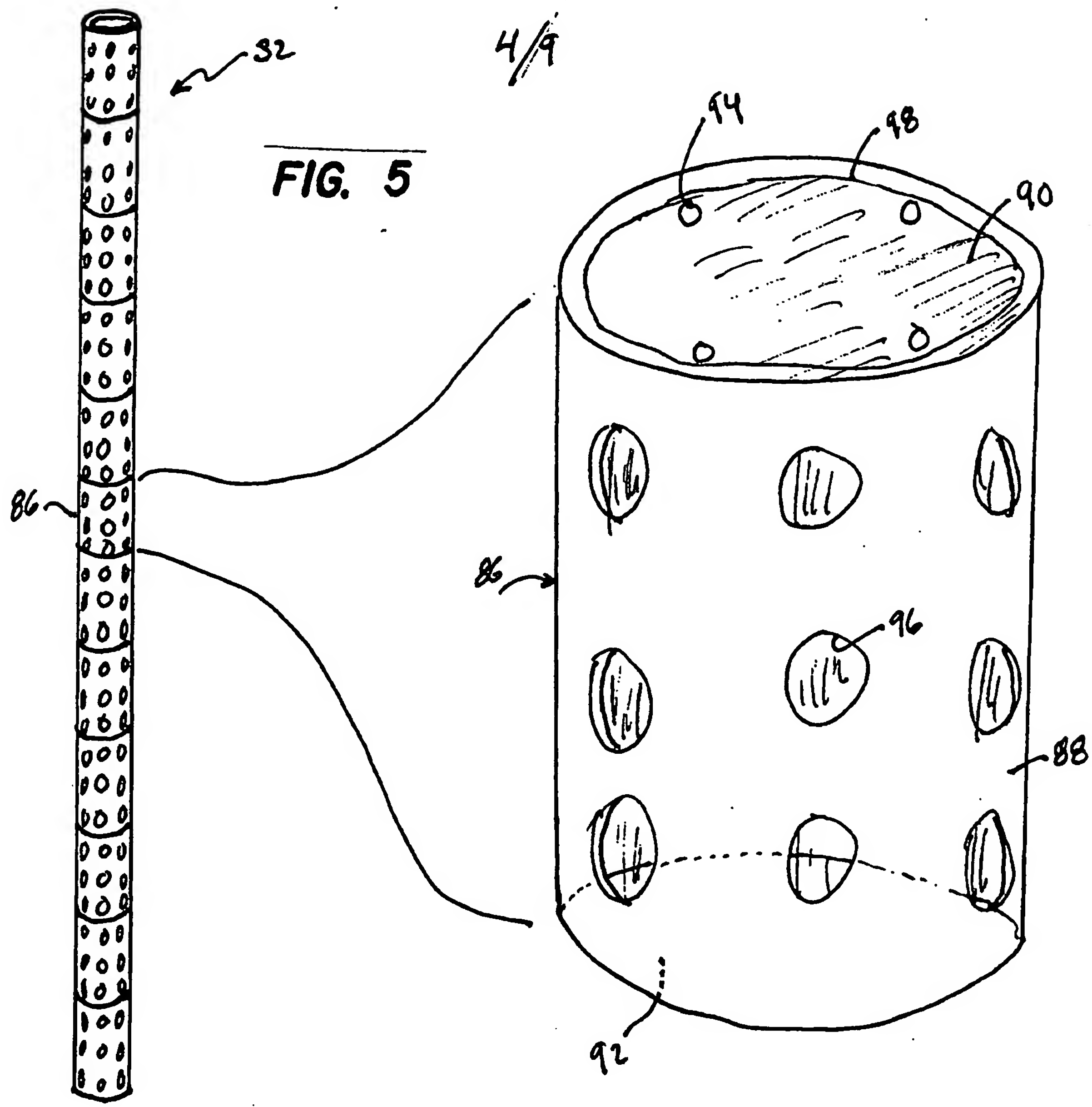
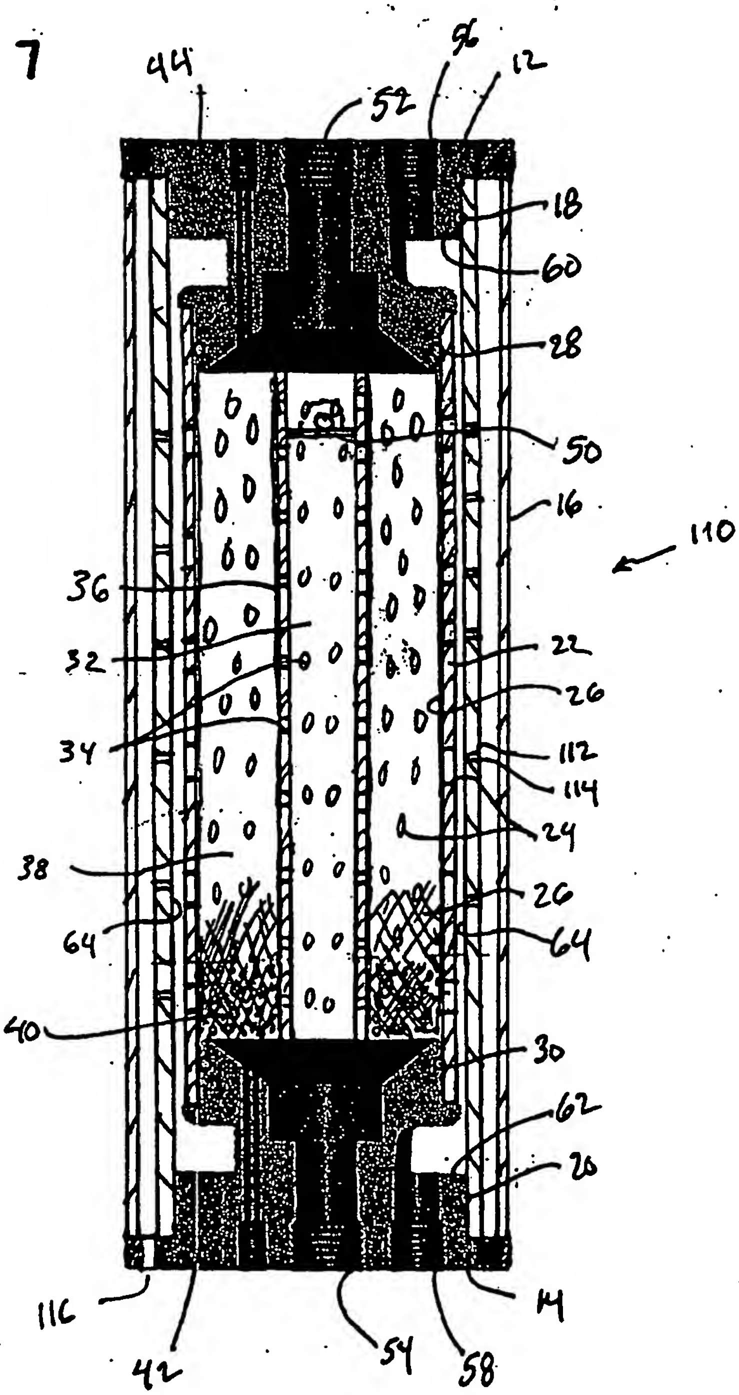


FIG. 7


44
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96
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18
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16
110
36
32
22
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114
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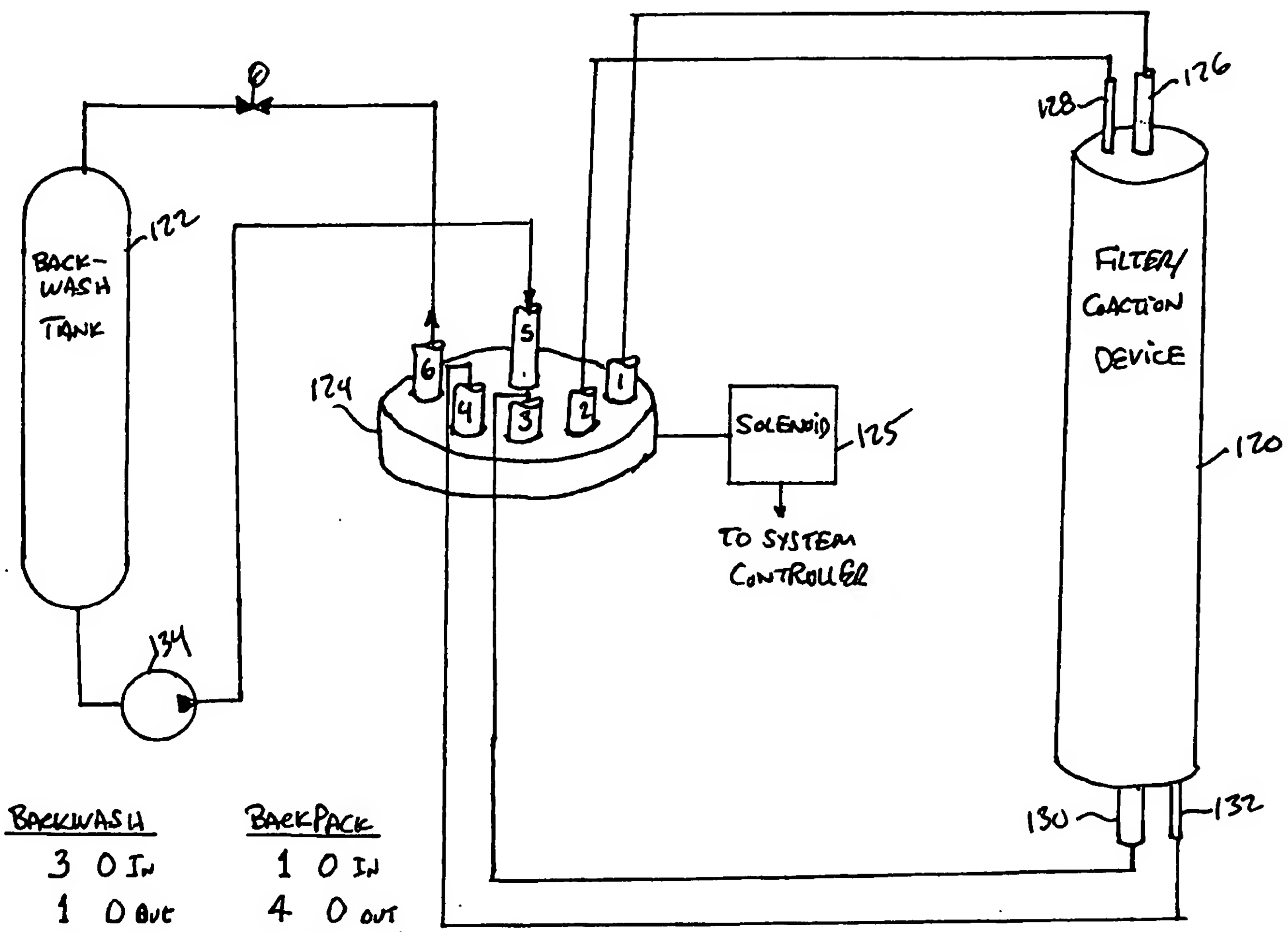
64
64
40
30
62
20
116
42
54
58
14

FIG. 8



FILTER		BACKWASH		BACKPACK	
1,2	O In	3	O In	1	O In
3	O Out	1	O Out	4	O out
4	Close Out	2,4	Closed	2,3	Closed Out

5,6 – ALWAYS OPEN

FIG. 9b

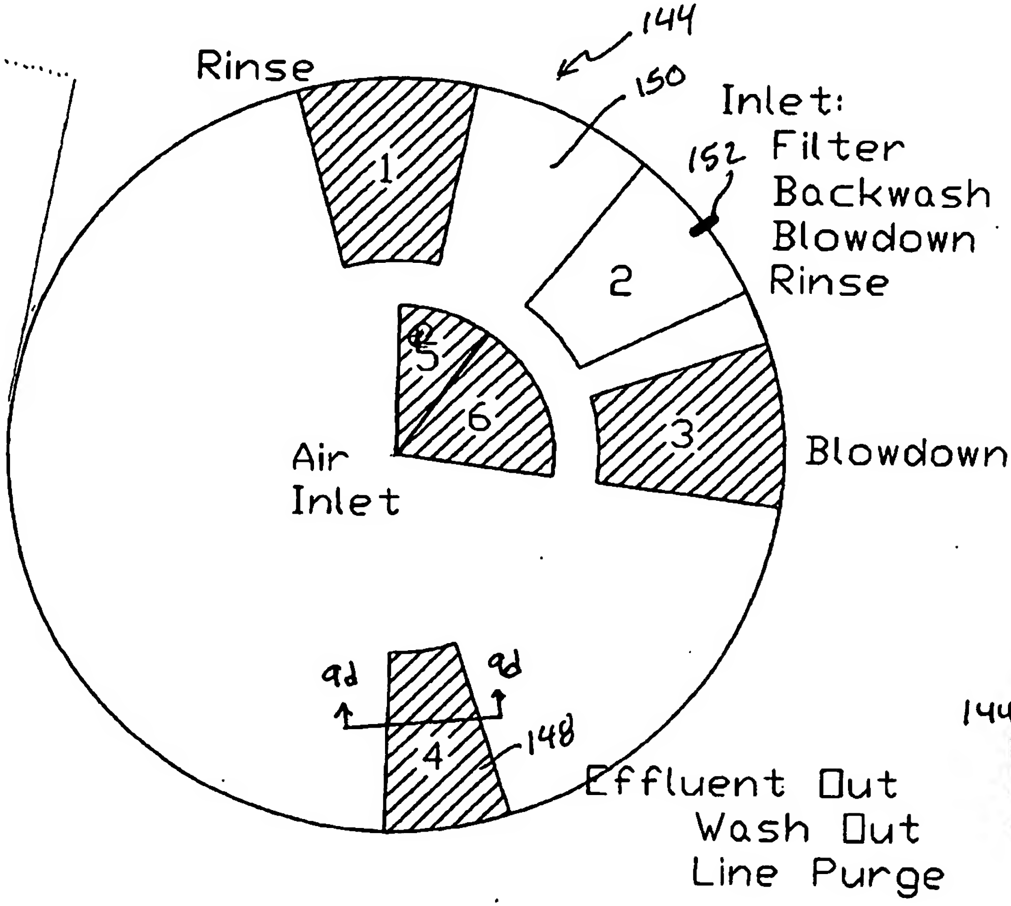


FIG. 9a

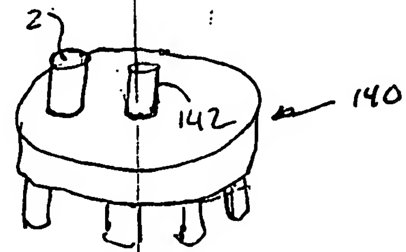


FIG. 9d

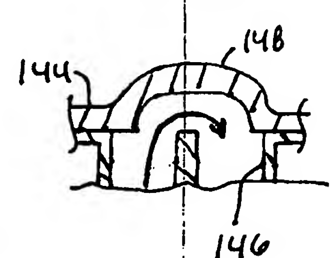


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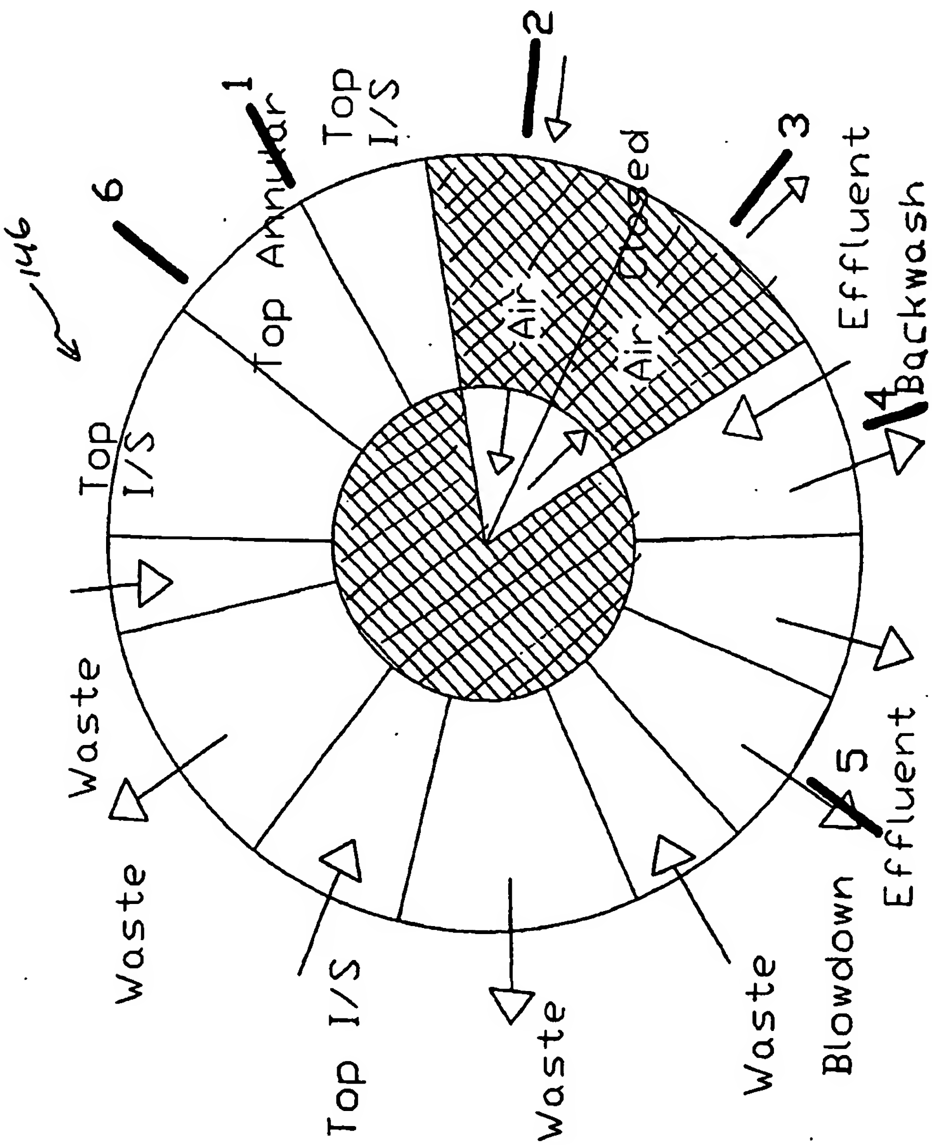
FIG. 9C



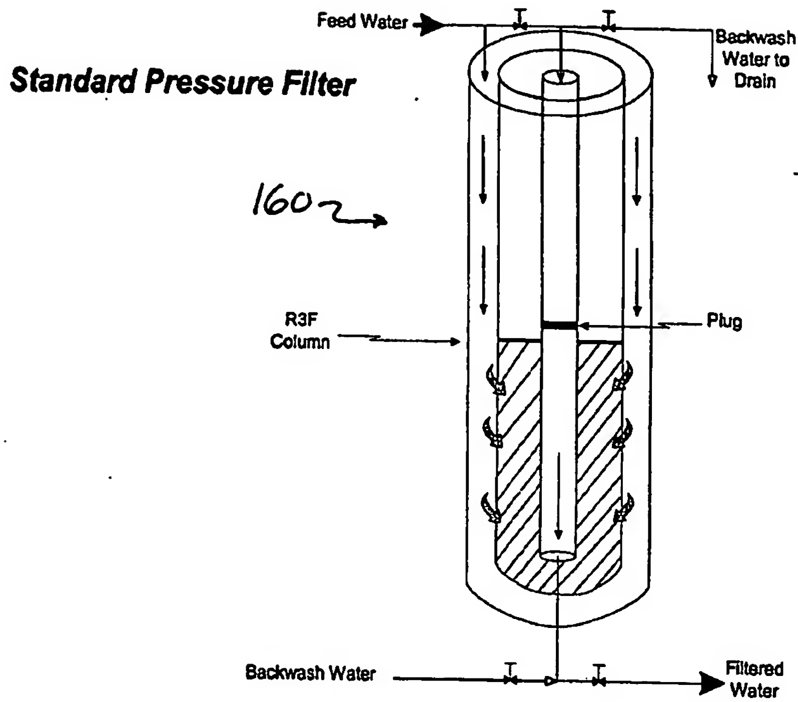

Feed Water
Backwash Water to Drain
Standard Pressure Filter
160
R3F Column
Plug
Backwash Water
Filtered Water

FIG. 11

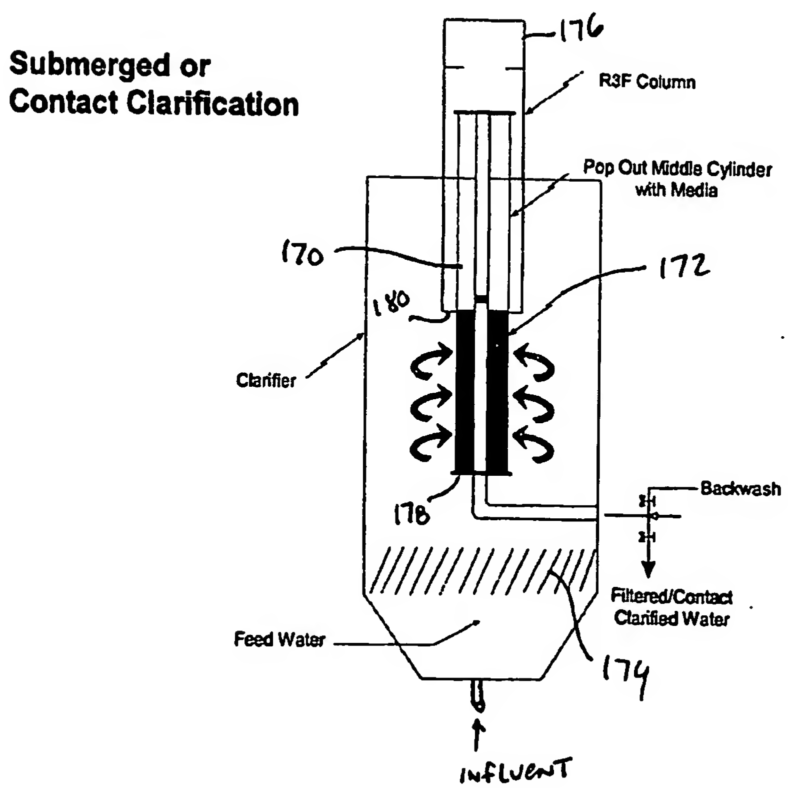

Submerged or Contact Clarification
176
R3F Column
Pop Out Middle Cylinder with Media
170
172
180
Clarifier
Backwash
178
Filtered/Contact Clarified Water
Feed Water
174
INFLUENT

FIG. 12

Document made available under the Patent Cooperation Treaty (PCT)

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